

USING SAS® SOFTWARE TO PROVIDE DESCRIPTIVE STATISTICS AND  
CUSTOMIZED REPORT WRITING FOR A MATERIALS MANAGEMENT FUNCTION

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ABSTRACT

One of the major responsibilities of Ameritech Services, Inc.'s Information Systems Organization (ISO) is to provide data processing application support and development for the purchasing and material management operations of the five Midwestern Bell Telecommunications Companies. As an Analyst within ISO, my functional area of concern is related to the Material Management And Distribution Systems for the warehouse Service Centers of the five Telecommunications Companies -- of primary interest here is Item Balance Integrity, or "IBI". The IBI System provides the user group with the information required to track measurement results and to detect problem areas relating to accurate item balances.

My recent SAS production application for IBI involves providing descriptive statistics and tailored report writing for balance adjustment historical data and for specific material stock identified as "attractive". The benefits derived from these developments include the following:

1. Assists the user, on a comparative basis (by warehouse and by reason code), to identify areas in need of internal auditing and corrective action, thereby facilitating the reduction of balance adjustments made due to errors.
2. Improves the integrity and accountability of inventory activities.
3. Enhances management decision making through pinpointing large-ticket and attractive items receiving disproportionate adjustments with the potential for savings by focusing measurement efforts upon costly and frequently adjusted items.

The introduction of SAS software to our materials management people has been rather straightforward and the success of our recent projects is an encouragement for further, more sophisticated applications.

INTRODUCTION

Information processing has indeed been taking on an ever increasing popular and important role in the improvement of warehouse management. Mr. Burr W. Hupp, former Executive Director of the Warehousing Education and Research Council, has referred to computers as valuable means for warehousing executives to make the most of their resources such as labor, material, space, and handling equipment [9]. Mr. William E. Dollar, CPM/CMC -- a noted purchasing/materials

management consultant, has recently stated that "...access to timely information will probably be the overriding key to success in materials management in the next 10 years" [4]. Reports generated from computers promote a unified, integrated approach to materials management. Of particular relevance to this writing is a fundamental reason for most companies' investment in computers: To speed the flow of information needed for making decisions and to provide those in positions of authority with valuable facts so they may take appropriate action on materials problems [1].

Many writers have documented creative applications of the computer to warehousing functions [5] [8] [11] [14]. And more specifically, several authors have focused in upon the use of data processing to provide timely and accurate information in the prevention of inventory shrinkage caused by pilferage [3] [7] [10] [12]. With the rising costs of materials comes the rising concern of warehouse managers regarding the destructive impact that unaccountable shrinkage has upon an organization's earnings. Industry specialists have found the costs of unexplained inventory shrinkages to be well over billions of dollars each year.

Mr. Norman Jaspan, a loss prevention expert, warns executives against complacency and of being overly trustful of employees or accepting high levels of thievery just because such losses are common throughout the industry [10]. In-house theft can be discouraged if employees know that warehouse management closely tracks the items in the facility. An effective management practice involves the monitoring of "attractive" items (i.e., stock which is readily converted to personal use, has a ready market value, or both and is therefore prone to a high risk of pilferage) where detailed information regarding these items is obtained and periodic physical inventory counts are conducted. Such a practice requires from our Information Systems Organization (ISO) the ability to generate timely reports depicting the firm's attractive items, their warehouse locations, dates of adjustment, dollar/quantity values, and reasons for balance adjustment.

Having the capability to identify stock receiving disproportionate balance adjustments is a very important step in preventing inventory shrinkage. Furthermore, such a capability certainly contributes to the accountability of inventory activities and to the performance measurement of warehouse personnel. According to industry observers, much of the warehouse shrinkage falls into three general categories: (1) receiving, (2) returns or transfers, and (3) shipping. By finding and accumulating data

regarding reasons for balance adjustments, specific areas in need of corrective action and perhaps internal audits can more easily be detected. Inventory shrinkage is an expensive and serious concern; understanding its cause(s) is crucial to effective materials management. Better management means lower costs and higher profits for the organization.

Our current Statistical Analysis System (SAS) application is designed to provide descriptive statistics and detailed reports regarding balance adjustment activity of all items warehoused by Ameritech Services for the five Midwestern Bell Telecommunications Companies (Illinois Bell, Indiana Bell, Michigan Bell, Ohio Bell, and Wisconsin Bell). As an Analyst within Ameritech Services' ISO, my functional area of responsibility is related to the Material Management And Distribution Systems (RMDS) for the five-state warehouses of the Telecommunications Companies -- of specific concern here is Item Balance Integrity, or "IBI".

A fundamental task of the IBI user group is to perform daily inventory of select stock/nonstock material; activities associated with this task include measuring, obtaining, and maintaining the accuracy of sample item balances. The IBI System provides the material management personnel with information necessary to track measurement results and to disclose problem areas relating to accurate item balances. In fulfilling our recent IBI development requirements, the SAS language was particularly advantageous because of its flexibility in meeting the users' needs in a timely fashion, ease of comprehension, and inherent statistical features [13].

#### METHOD AND CONTENT

Based upon discussions with the regional Materials Manager, I identified two fundamental objectives or needs that are not being fulfilled by the present IBI System. The first of these needs is to obtain detailed reports and descriptive statistics regarding all balance adjustment historical data, according to reason codes, for a user-specified time period. The listings and statistics are to be generated on an individual basis for each warehouse as well as on a regional level depicting the comparative balance adjustment activities of all the warehouses. Through modifications to existing source modules, I have created extract files from the data base which are used as SAS input files for the production process.

The user's emphasis was not only upon the dollar amounts, but also upon the reasons for the balance adjustments. One of the following IBI reason codes must accompany each adjustment to the balances:

A: Annual Inventory Error	P: Programming Error
C: Clerical Receipts Error	R: Warehouse Receipts Error

D: Unit Conversion Error	S: Selection Error
E: Counting Error	T: Returns Error (Telco)
H: Purification Error	W: Putaway Error
M: Mechanized Locator System Error	X: Returns Error (ASI)

Through using basic data flow diagrams and project specifications, the regional IBI Materials Manager and I were able to attain a mutual understanding of what reports and statistics were required. Initial design guidelines for the reports and their contents were as follows:

- A. A listing of all items incurring a balance adjustment within the user-specified time period. The listing contains general information and data items of interest here include: Service Center (warehouse) I.D., Item Number, Item Description, Material Class, Cost, Cost Multiplier, Adjustment Date, Reason Code, Dollar Amount of Adjustment, and Adjustment Quantity. The listing is sorted by warehouse and by item description.
- B. Illustrations of adjustment reason code frequencies by warehouse.
- C. Frequency histograms of reason codes with Service Center I.D.'s used along the horizontal axis for comparative purposes.
- D. Bar chart summations of balance adjustments made in dollars by Service Center, by reason code.
- E. At the regional level, a matrix table of adjustment reason code frequencies by Service Center.
- F. Summary statistics regarding adjustment dollar amounts by Service Center and reason code.
- G. Illustrations of adjustment dollar amount summations by reason code, with corresponding frequency distributions for each warehouse.

The reports should contain the current date as well as the beginning and ending dates of which the historical data is associated. The regional and warehouse level jobs are scheduled to run at each fiscal month-end, but they may process earlier or later depending upon the needs of the user. The more pragmatic descriptive statistics used here, and ones likely to be given genuine attention and receive correct interpretation by those reviewing the information, include: frequencies, percentages, means, minimum/maximum values, ranges, sums, standard deviations, and variances.

The second need identified involves obtaining a complete listing of all attractive items, at any point in time, for each of the five-state warehouses. From our present file maintenance procedures, the user has the capability to flag

items on the data base as being attractive. Again, data extraction modules have been implemented to create the required SAS input files for this application.

The user's major concern here was to design a report containing the following information: Service Center I.D., Attractive Item Number, Item Description, Material Class, Warehouse Location, Calendar Date of Last Count, Date of Last Adjustment, and Cumulative Number of Negative Adjustments per Item. To compliment this SAS application, a few existing COBOL modules were modified so that the attractive items receiving a negative adjustment during the current fiscal month would then trigger accompanying COBOL report programs that provide further in-depth historical facts (e.g., balance before and after the adjustment, backorder dates and quantities, open order information, receipts details, etc.).

The attractive item reports should contain the current date and are routed to the respective warehouses, with copies sent to the regional IBI Materials Manager. The jobs are scheduled to run at each fiscal month-end, but they too may process earlier or later depending on the needs of user. Frequency distributions and percentages according to material class are also provided.

RESULTS

The SAS application to the balance adjustment historical data resulted in the generation of nineteen reports in total. Many of the listings

were further categorizations according to net, positive only, and negative only dollar balance adjustments. To aid in the manageability of such a lengthy output, a "TABLE OF CONTENTS" is provided at the outset of the listing and banner pages with titles separate each of the reports. Though only a handful of examples may be presented here due to time and space limitations, the overall accomplishment may still be easily understood.

Exhibit I (below) is an example of the report "POSITIVE AND NEGATIVE BALANCE ADJUSTMENT DATA". As one can see, the listing is for the Michigan Service Center ("MC") and it contains all of the aforementioned data items requested by the user (Exhibits contain test data only). The time period of interest here is June 29, 1985 to July 26, 1985 and the current report date is August 12, 1985. For the Michigan warehouse, the total number of balance adjustments made for that fiscal month is 463 and the total net in adjustment dollars equals a positive \$19,797.71. Note that this report could easily be broken down to a subset of items receiving positive and/or negative adjustments in excess of, say, \$1,000.00 should the user want to focus attention on such material.

Exhibit II illustrates the report of "I.B.I. SUMMARY STATISTICS BY SERVICE CENTER AND REASON CODES". The continuous variable of interest is the adjustment dollar amounts, both positive and negative, and the legend within the title presents the meaning of each of the reason codes. To facilitate appropriate

Exhibit I: Sample Report Of POSITIVE AND NEGATIVE BALANCE ADJUSTMENTS DATA

ITEM BALANCE INTEGRITY									
REGIONAL MATERIAL DISTRIBUTION SYSTEMS									
PERIOD DATE BEGINNING: JUNE 29, 1985					PERIOD DATE ENDING: JULY 26, 1985				
***** MONTHLY IBI STATISTICS FOR THE CURRENT REPORT DATE OF: AUGUST 12, 1985 *****									
SC-ID	ITEM-NO	ITEM DESCRIPTION	M-CLASS	CUST	COST-MLT	ADJ-DATE	R-CODE	ADJ-\$'S	ADJ-QNTY
MC	80780	1245 2219 MAINF. KIT	N	\$2.82		08JUL1985	S	\$173.44	2
	87890	TRANSFORMER 2010 C #9	N	\$16.82		23JUL1985	S	\$114.00	26
	27930	TRAY ASH MOTTLED HAL A3	N	\$1.74		26JUL1985	H	\$-0.00	-6
	25360	TURBINE PLSTC C 3/8X10 AT*	N	\$1.41		26JUL1985	H	\$-0.00	-1
	48918	WIRE 24 1/2LB POLISHED	N	\$1.41		26JUL1985	H	\$47.69	85
	48918	UNIT POWER 20 B 4	N	\$4.83		26JUL1985	H	\$-4.17	-1
	20552	UNIT POWER 28 D 2	N	\$20.25		10JUL1985	R	\$364.20	2
	25690	UNIT TEL KEY 13C	C	\$18.09		10JUL1985	R	\$614.58	2
	85870	UNIT TEL KEY 4810	C	\$1.02		10JUL1985	R	\$-135.80	-2
	85870	UNIT TEL KEY 4810	C	\$21.74		10JUL1985	R	\$-210.34	-3
	80116	VARIATOR 1000	N	\$16.04		10JUL1985	R	\$241.02	6
	25932	WALLET FILE EXPANDING WCB	N	\$22.68		22JUL1985	H	\$-0.43	-2
	25932	WALLET FILE EXPANDING WCB	N	\$22.68		19JUL1985	H	\$-15.48	-25
	25932	WASHER CURVED 8 AT6150	N	\$22.03		01AUG1985	S	\$8.49	2
	71747	WASHER S LMG C 7 P4AT0583	N	\$22.45		11JUL1985	S	\$-75.82	-200
	29116	WASHER SQ 3/4X21/4 AT6150	N	\$32.18		11JUL1985	S	\$-245.00	-699
	29116	WASHER LEAD 2 AT6150	N	\$29.54		12JUL1985	S	\$-32.77	-246
	29116	WASHER LEAD 2 AT6150	N	\$29.54		22JUL1985	S	\$-14.34	-49
	29162	WIRE GRD 119	N	\$209.76		22JUL1985	H	\$1.31	3
	30201	WIRE ASW6/22F 3500 FT RL	N	\$10.51		22JUL1985	H	\$-59.99	-7
	80780	WIRE SLUCK 8 QUAD AT8100	N	\$-80.87		17JUL1985	S	\$645.08	3,906
	80780	WIRE BLOCK 8 IPR AT8100	N	\$111.60		10AUG1985	S	\$-19.62	-250
	78126	WIRE FR DIST D122P WH/BL	N	\$0.59		11JUL1985	S	\$-10.55	-280
	10069	WIRE FR DIST D122P-W/R	N	\$28.50		25JUL1985	S	\$343.20	24,600
	80780	WIRE FR DIST D122P	N	\$57.02		10JUL1985	S	\$966.00	60,000
	30532	WIRE FR DIST 1200599 22GA	N	\$38.20		12JUL1985	S	\$-1,372.80	-96,000
	30533	WIRE FR DIST 1200699 22GA	N	\$50.40		10JUL1985	S	\$36.49	2,100
	80780	WIRE FR DIST 1200799 22GA	N	\$80.30		10JUL1985	S	\$1,525.00	50
	29310	WIRE GRD 12 AT7088	N	\$102.45		15JUL1985	S	\$93.90	3
	29310	WIRE GRD 12 AT7088	N	\$6.71		09JUL1985	S	\$-714.38	-23
	80780	WIRE GRD 6 SOFT DRW 50CL	N	\$6.71		10JUL1985	S	\$31.27	1
	80780	WIRE GRD 6 SOFT DRW 50CL	N	\$6.71		10JUL1985	S	\$8.27	200
	80780	WIRE ISH STL CO4S 1200A18	N	\$10.19		10JUL1985	S	\$20.60	100
	45084	WIRE STA H 3PR 1500FT COIL	N	\$4.28		15JUL1985	S	\$-19.78	-150
	45330	WIRE STA H 3PR 400FT F8CL	N	\$8.30		10JUL1985	S	\$-400.32	-36
	80780	WIRE LINK 8057N	N	\$8.00		24JUL1985	S	\$-37.08	-1
	80780	WRENCH PROT 8 AT7289	N	\$1.44		10JUL1985	S	\$-153.83	-4,395
	10888	8405 97587 REAR PANEL	N	\$33.00		22JUL1985	S	\$374.74	254
	10894	8405 97603 REAR PANEL	N	\$71.28		26JUL1985	S	\$65.55	23
	10894	8405 97603 REAR PANEL	N	\$71.28		26JUL1985	S	\$-17.72	-10
	11002	8405 97602 FACEPLATE	N	\$3.88		26JUL1985	S	\$-27.76	-12
	11002	8405 97604 FACEPLATE	N	\$236.40		26JUL1985	S	\$7.87	1
	11024	8405 97726 FACEPLATE	N	\$5.77		26JUL1985	S	\$7.87	1
	8416 34165	8405 97793 FACEPLATE	N	\$5.10		26JUL1985	S	\$24.66	2
	8416 34165	8416 34165 WIK CONN CK F3PR	N	\$1.46		26JUL1985	S	\$-58.64	-3
	8416 34165	8416 34165 WIK CONN CR F3PR	N	\$693.00		09JUL1985	S	\$-170.40	-24,000
	44234	8416 34165 CONN LUG-IT	N	\$2,428.00		08JUL1985	S	\$-121.46	-7,230
				\$2,428.00		02JUL1985	H	\$-59.73	-31
								\$19,797.71	

interpretation, a letter containing descriptive statistic definitions and explanations (with examples) was distributed to the users at the warehouse and regional levels prior to production runs. This communication was important in that it anticipated valid user concerns, made the newly applied statistics a bit more palatable, and helped to clarify the overall intent of the development.

The reports of this project and their use represent a change within the IBI System and change has a greater potential for being accepted when it is understood.

Exhibit III is a sample of the report "BAR CHART: NEGATIVE BALANCE ADJUSTMENTS BY REASON CODE." This histogram is of particular value at the regional level because each of the

Exhibit II: Sample Report Of I.B.I. SUMMARY STATISTICS BY SERVICE CENTER AND REASON CODES

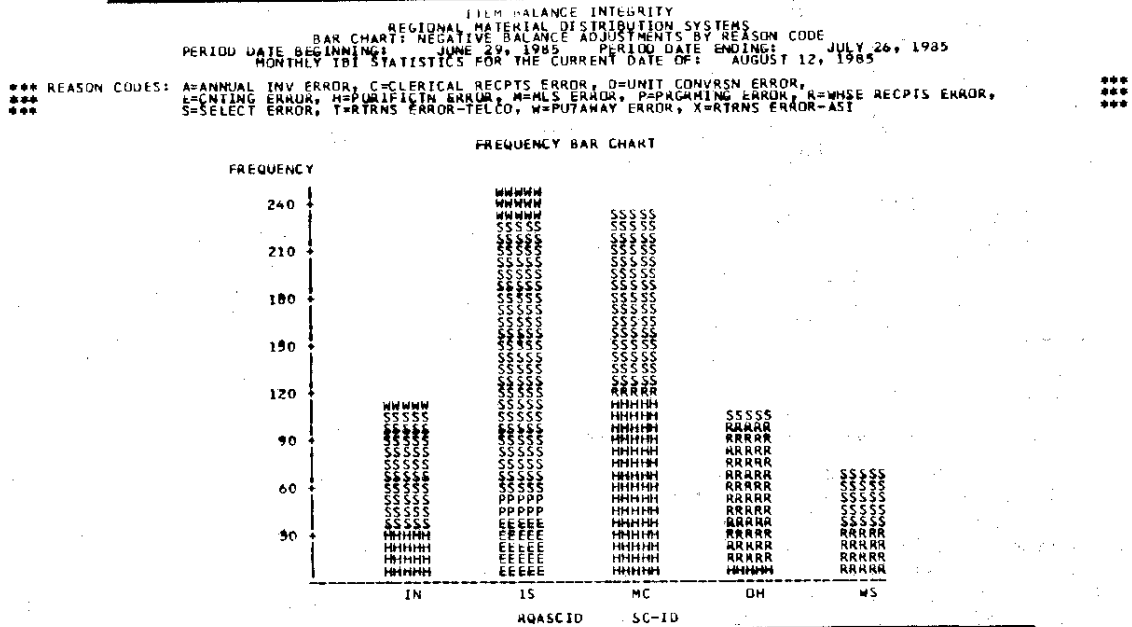
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\*\*\* I.B.I. SUMMARY STATISTICS BY SERVICE CENTER AND REASON CODES \*\*\*  
 \*\*\* POSITIVE AND NEGATIVE ADJUSTMENTS \*\*\*  
 \*\*\* CONTINUOUS VARIABLE ADJUSTMENT DOLLAR AMOUNTS \*\*\*  
 PERIOD DATE BEGINNING: JUNE 29, 1985 PERIOD DATE ENDING: JULY 26, 1985  
 MONTHLY IBI STATISTICS FOR THE CURRENT DATE OF: AUGUST 12, 1985

\*\*\* REASON CODES: A=ANNUAL INV ERROR, C=CLERICAL RECPTS ERROR, D=UNIT CONVRSN ERROR, L=ENTING ERROR, H=PURIFICTN ERROR, M=MLS ERROR, P=PRGRMNG ERROR, R=WHSE RECPTS ERROR, S=SELECT ERROR, T=TRNS ERROR-TELCO, W=PUTAWAY ERROR, X=TRNS ERROR-ASI

VARIABLE	LABEL	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	RANGE	STD ERROR OF MEAN	SUM	VARIANCE
RQAADOL	ADJ-\$'S	70	-31.96071429	463.1067762	-3012.750000	1125.400000	4138.150000	55.35184681	-2237.250000	214467.0861
RQAADOL	ADJ-\$'S	22	-5.16363636	1951.316720	-4469.940000	4469.940000	8939.880000	416.0221226	-113.600000	3007636.943
RQAADOL	ADJ-\$'S	4	482.12250000	2555.497087	-2985.600000	2516.200000	5501.800000	1277.748543	-1808.490000	8530965.361
RQAADOL	ADJ-\$'S	291	-92.95735395	916.8152013	-10637.340000	2001.430000	12638.770000	53.74465892	-27056.590000	840556.1134
RQAADOL	ADJ-\$'S	44	-40.71522727	1181.905321	-5611.440000	3971.880000	9583.320000	178.1789313	-1791.470000	1376900.188
RQAADOL	ADJ-\$'S	7	162.43571429	369.9375212	-14.72000000	985.71000000	1000.43000000	139.8232402	1137.050000	136853.7696
RQAADOL	ADJ-\$'S	190	-43.97521053	288.0382787	-2796.700000	610.48000000	3407.180000	20.09649303	-6353.290000	82966.04998
RQAADOL	ADJ-\$'S	39	267.57666667	437.2714428	-706.20000000	1717.50000000	2423.70000000	70.01946884	10455.490000	191206.3146
RQAADOL	ADJ-\$'S	226	83.69234513	1210.501709	-4748.400000	12504.200000	17252.600000	80.52137591	18914.470000	1465314.387
RQAADOL	ADJ-\$'S	8	-149.62000000	923.7294708	-1678.900000	749.40000000	2428.300000	326.5876864	-1196.960000	853276.1352
RQAADOL	ADJ-\$'S	1	-179.08000000		-179.08000000	-179.08000000	0		-179.08000000	

Exhibit III: Sample Histogram Or BAR CHART: NEGATIVE BALANCE ADJUSTMENTS BY REASON CODE



warehouses is grouped along the horizontal axis and the class frequencies (number of negative adjustments made by reason code) are represented along the vertical axis. The rectangles contain the corresponding reason codes whose heights are determined by the respective class frequencies. Therefore, on a comparative basis, the regional IBI Materials Manager can identify areas requiring attention for each of the Service Centers. In this case, for example, the Illinois Service Center ("IS") seems to have a disproportionate number of negative adjustments caused by Selection Errors ("S"). Used as a measure of performance, the personnel responsible for the inventory activity of selection may be informed of the need for future improvement and fewer errors.

The CROSSTABULATION (Exhibit IV) and PIE CHART (Exhibit V) are especially relevant at the regional level and when used together, they

corresponding percentages, by reason code. For example, from the CROSSTABULATION, we find that the frequencies and percentages of balance adjustments made due to select errors ("S") for each warehouse are as follows:

IN: 112(8.05%) IS: 291(20.91%) MC: 226(16.24%)  
OH: 14(1.01%) WS:50(3.59%)

The total number of select errors equals 693 or 49.78 percent of all adjustments made from June 29, 1985 to July 26, 1985. These total values for reason code "S" are then represented in the PIE CHART. Other reports associated with the balance adjustment historical data, but not presented here, include cumulative frequency bar charts and additional histograms depicting the various occurrences of reason codes and adjustment dollar amounts for each of the Service Centers.

Exhibit IV: Sample Of CROSSTABULATION OF ADJUSTMENT REASON CODES BY SERVICE CENTER

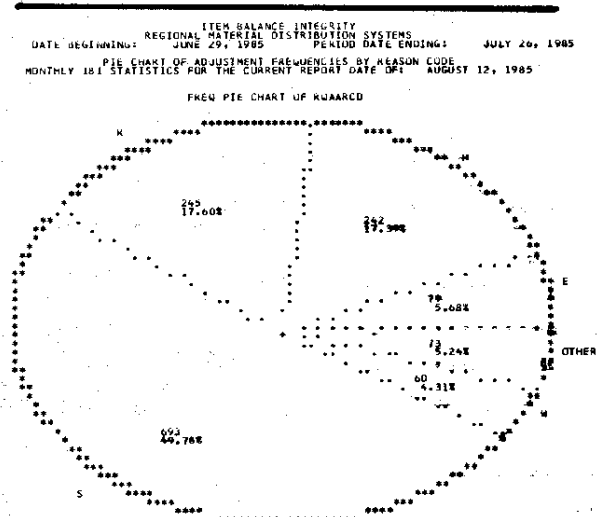
ITEM BALANCE INTEGRITY  
\*\*\* POSITIVE AND NEGATIVE ADJUSTMENTS \*\*\*  
PERIOD DATE BEGINNING: JUNE 29, 1985 PERIOD DATE ENDING: JULY 26, 1985  
MONTHLY IBI STATISTICS FOR THE CURRENT DATE OF: AUGUST 12, 1985

A=ANNUAL INV ERROR, C=CLERICAL RECPTS ERROR, D=UNIT CONVRSN ERROR,  
B=COUNTING ERROR, M=PURIFICATION ERROR, H=MSL'S ERROR, P=PROGRAMING ERROR, R=WHSE RECPTS ERROR,  
S=SELECT ERROR, T=TRNS ERROR-TELCO, W=PUTAWAY ERROR, X=TRNS ERROR-ASI

TABLE OF RQAARCD BY RQASCID

RQAARCD	R-CODE	RQASCID	SC-ID	FREQUENCY PERCENT	ROW PCT	COL PCT	
C	I	IS	0	0.07	0.07	0.07	
		MC	0	0.00	0.00	0.00	
		OH	1	0.07	0.07	0.07	
		WS	4	0.29	0.29	0.29	
		TOTAL	14	10.00	10.00		
		PERCENT	0.51	0.23	0.00	0.53	
D	I	IS	0	0.07	0.07	0.07	
		MC	0	0.00	0.00	0.00	
		OH	0	0.00	0.00	0.00	
		WS	0	0.00	0.00	0.00	
		TOTAL	0	0.00	0.00		
		PERCENT	0.91	0.23	0.00	0.00	
E	I	IS	70	0.29	0.29	0.29	
		MC	0	0.00	0.00	0.00	
		OH	1	0.07	0.07	0.07	
		WS	4	0.29	0.29	0.29	
		TOTAL	75	5.00	5.00		
		PERCENT	0.96	0.61	0.08	0.37	
H	I	IS	0	0.00	0.00	0.00	
		MC	190	0.79	0.79	0.79	
		OH	11	0.08	0.08	0.08	
		WS	0	0.00	0.00	0.00	
		TOTAL	201	1.00	1.00		
		PERCENT	21.03	0.00	41.04	5.85	
M	I	IS	0	0.00	0.00	0.00	
		MC	0	0.00	0.00	0.00	
		OH	0	0.00	0.00	0.00	
		WS	0	0.00	0.00	0.00	
		TOTAL	0	0.00	0.00		
		PERCENT	1.03	0.00	0.00	0.00	
P	I	IS	22	0.00	0.00	0.00	
		MC	0	0.00	0.00	0.00	
		OH	0	0.00	0.00	0.00	
		WS	1	0.07	0.07	0.07	
		TOTAL	23	0.00	0.00		
		PERCENT	0.08	1.58	0.00	0.94	
R	I	IS	4	0.17	0.17	0.17	
		MC	39	0.23	0.23	0.23	
		OH	150	0.92	0.92	0.92	
		WS	4	0.02	0.02	0.02	
		TOTAL	197	0.92	0.92		
		PERCENT	1.03	0.91	8.42	41.51	
S	I	IS	291	8.05	8.05	8.05	
		MC	226	16.24	16.24	16.24	
		OH	14	1.01	1.01	1.01	
		WS	50	3.59	3.59	3.59	
		TOTAL	581	49.78	49.78		
		PERCENT	57.44	66.14	7.45	47.17	
T	I	IS	0	0.00	0.00	0.00	
		MC	0	0.00	0.00	0.00	
		OH	4	0.29	0.29	0.29	
		WS	0	0.00	0.00	0.00	
		TOTAL	4	0.00	0.00		
		PERCENT	16.77	0.00	2.13	0.00	
W	I	IS	44	0.29	0.29	0.29	
		MC	8	0.05	0.05	0.05	
		OH	0	0.00	0.00	0.00	
		WS	23	0.17	0.17	0.17	
		TOTAL	75	0.51	0.51		
		PERCENT	2.05	10.00	1.73	2.83	
X	I	IS	7	0.56	0.56	0.56	
		MC	50	0.00	0.00	0.00	
		OH	0	0.00	0.00	0.00	
		WS	0	0.00	0.00	0.00	
		TOTAL	57	0.00	0.00		
		PERCENT	3.59	1.59	0.00	0.00	
TOTAL		195	440	463	188	106	1392
		14.01	31.61	33.26	13.51	7.61	100.00

EXHIBIT V: Sample PIE CHART OF ADJUSTMENT FREQUENCIES BY REASON CODES For All Service Centers Combined



provide an effective comparative base for assessing adjustment activities. Exhibit IV shows both the row and column frequencies and percentages (individually and in total) for each reason code and warehouse, respectively. Exhibit V represents a pictorial display of the total number of adjustments made, with

Exhibit VI represents the main SAS application with respect to attractive material (by Service Center) and is an example of the "REPORT OF ALL CURRENT ATTRACTIVE ITEMS BY ITEM DESCRIPTION." Each of the aforementioned data items is present in the listing and the report is of particular benefit to the Balance Investigator(s) at the warehouse. The Investigator may now find which attractive items are receiving an unusual number of recent negative adjustments and may prioritize research and tracking efforts upon such stock. Furthermore, the report enhances the accountability of attractive item adjustments by displaying the calendar date when the material was last counted and the date when the material's balance was adjusted.

Exhibit VI: Sample REPORT OF ALL CURRENT ATTRACTIVE ITEMS BY ITEM DESCRIPTION

ILLINOIS SERVICE CENTER  
 ITEM BALANCE INTEGRITY  
 REGIONAL MATERIAL DISTRIBUTION SYSTEMS  
 REPORT OF ALL CURRENT ATTRACTIVE ITEMS  
 BY ITEM DESCRIPTION  
 \*\*\* CURRENT DATE: AUGUST 26, 1985 \*\*\*

ITEM NO	ITEM DESCRIPTION	CLASS	WHSE LOCA	CAL-DATE LAST COUNT-C	CAL-DATE LAST COUNT-NEW	DATE OF LAST ADJUST	NEG ADJUST CLASS C	NEG ADJUST CLASS NEW
IS11988	DRILL HSNRY B 3/8X6 AT*	N	DDHA3	18APR1985	20AUG1985	20AUG1985	0	4
IS11984	DRILL HSNRY B 3/8X6	N	DDH11	18APR1985	18APR1985	18APR1985	0	1
IS35980	DRILL HSNRY B 3/8X18 AT*	N	DDG32	29SEP1984	29SEP1984	29SEP1984	0	0
IS11970	DRILL HSNRY B 3/8X6 AT*	N	DDG32	03MAY1985	14AUG1985	21JAN1985	0	2
IS11996	DRILL HSNRY B 5/8X18	N	DDG81	29SEP1984	29SEP1984	21JAN1985	0	1
IS11998	DRILL HSNRY B 5/8X18	N	DDH43	29SEP1984	29SEP1984	29SEP1984	0	0
IS11992	DRILL HSNRY B 7/16X6	N	DDG31	18APR1985	18APR1985	18APR1985	0	0
IS14000	DRILL HSNRY L 1/2X31/32	N	DDF31	08MAY1985	08MAY1985	08MAY1985	0	1
IS14080	DRILL HSNRY L 1/2X31/32	N	DEB31	15MAY1985	15MAY1985	15MAY1985	0	1
IS14078	DRILL HSNRY L 3/16 AT6558	N	FFH42	15MAY1985	30AUG1985	18MAR1985	0	1
IS14082	DRILL HSNRY L 3/16 AT6558	N	FFH43	15MAY1985	11JUN1985	26MAR1985	0	2
IS14096	DRILL HSNRY L 5/8X6	N	DDA11	13JUL1985	11JUN1985	10DEC1984	0	0
IS14098	DRILL HSNRY L 5/8X6	N	DDB21	29JUN1985	13JUL1985	21JAN1985	0	2
IS14099	DRILL HSNRY L 7/16 AT6558	N	DDE31	29JUN1985	29JUN1985	21JAN1985	0	0
IS14088	DRILL HSNRY PERCUS 3/8	N	DDI33	29SEP1984	29SEP1984	04SEP1984	0	0
IS14174	DRILL HSNRY PERCUS 3/8	N	DDI42	01AUG1985	01AUG1985	01AUG1985	0	0
IS14176	DRILL HSNRY PERCUS 5/16	N	DDI22	29SEP1984	29SEP1984	29SEP1984	0	0
IS14178	DRILL HSNRY PERCUS 5/16	N	DDI22	03AUG1985	03AUG1985	29SEP1984	0	0
IS14086	DRILL TM HS 50	N	DDG11	20NOV1984	20NOV1984	21JAN1985	0	1
IS14094	DRILL TM HS 50	N	DDG82	20NOV1984	20NOV1984	21JAN1985	0	0
IS14124	DRILL TM HS 50 5/16	N	DDF33	20NOV1984	20NOV1984	28JAN1985	0	1
IS14130	DRILL TM HS 50 5/16	N	DDG33	21MAY1985	21MAY1985	21MAY1985	0	0
IS14132	DRILL TM WIRE 1	N	DDC11	29SEP1984	29SEP1984	29SEP1984	0	1
IS14142	DRILL TM WIRE 1	N	DDH11	29SEP1984	29SEP1984	16JUL1984	0	0
IS14148	DRILL TM WIRE 18	N	DDH42	29SEP1984	18MAY1985	21JAN1985	0	1
IS14174	DRILL TM WIRE 20	N	DDC11	02MAY1985	02MAY1985	21JAN1985	0	1
IS14176	DRILL TM WIRE 22	N	DDF33	07DEC1984	07DEC1984	21JAN1985	0	0
IS14178	DRILL TM WIRE 24	N	DDG82	05JUN1985	05JUN1985	05JUN1985	0	2
IS14190	DRILL TM WIRE 27	N	DDF22	21NOV1984	21NOV1984	21JAN1985	0	2
IS14198	DRILL TM WIRE 29	N	DDH33	07AUG1985	07AUG1985	07AUG1985	0	2
IS14200	DRILL TM WIRE 30	N	DDH22	29SEP1984	29SEP1984	21JAN1985	0	1
IS14196	DRILL TM WIRE 32	N	DDF42	20NOV1984	20NOV1984	20NOV1984	0	1
IS14198	DRILL TM WIRE 33	N	DDF33	20NOV1984	20NOV1984	21JAN1985	0	1
IS14202	DRILL TM WIRE 34	N	DDF22	30APR1985	20NOV1984	20NOV1984	0	1
IS14204	DRILL TM WIRE 36	N	DDF43	20NOV1984	20NOV1984	29SEP1984	0	0
IS14120	DRILL TM 1/2	N	DDH33	01JUN1985	01JUN1985	29APR1985	0	2
IS14118	DRILL WIRE HIGH SPEED 28	N	DDI43	17MAY1984	17MAY1984	21JAN1985	0	1
IS14192	DRILL WIRE HIGH SPEED 28	N	DDC11	20NOV1984	20NOV1984	21JAN1985	0	1

CONCLUSION

My application of SAS Software to balance adjustment historical data and to attractive items is a first among our Material Management And Distribution Systems. COBOL, Assembler, FORTRAN, and FOCUS are the prevailing standard operating languages in our OS environment and so the use of SAS within IBI has received special attention from ISO. Furthermore, when used for a stand-alone project, as well as for a project incorporating modules of differing source languages, SAS has proven to be quite flexible and expeditious in meeting user group requirements.

The recent SAS development is a timely one in that the materials management personnel at each of the five Service Centers will soon participate in annual inventory - an event where the differences between item quantities determined through physical inventory counts and the quantities existing on the perpetual inventory computer master file must be reconciled. During this operation, several adjustments will be made to both attractive and non-attractive stock balances. The SAS reports generated upon completion of annual inventory will be extremely useful to the internal auditing staff and materials managers in revealing occurrences of unexplained losses and gains as well as instances of potential

pilferage. An underlying assumption here is that the appropriate and accurate reason code will accompany each balance adjustment; the importance and realm of responsibility for this has been made explicitly clear to the user and to do otherwise would result in the well-publicized "garbage in, garbage out" phenomenon. Maintaining the integrity of input data is especially relevant with respect to preventing costly inventory shrinkages.

What was of critical importance to the application's success was the open communication between the user group and the Analyst. During the development phase, continuous feedback and user input to refinements in design were the norm. Energy devoted to coding and testing was fractional relative to my previous experience using other languages. In addition, due to the user friendliness of SAS, the time and cost elements associated with such maintenance tasks as post-production debugging, making changes due to the environment, and enhancing report and/or file attributes were significantly reduced.

The introduction of SAS to our materials management people has generated encouragement for future, more sophisticated statistical analyses. Some examples of potential uses to warehousing operations may include:

- regression models for predicting demand

- quantities of seasonal and/or critical items,
- t-tests for comparing mean inventory carrying costs among an organization's multiple warehousing sites, and
- linear programming for determining cost effective shipping and handling of materials.

In summation, the benefits derived from the application of SAS to the IBI materials management function are threefold:

1. Assists the user, on a comparative basis (by warehouse and reason code), to identify areas in need of internal auditing and corrective action, thereby facilitating the reduction of balance adjustments made due to errors.
2. Improves the integrity and accountability of inventory activities.
3. Enhances management decision making through pinpointing large-ticket and attractive items receiving disproportionate adjustments with the potential for savings by focusing measurement efforts upon costly and frequently adjusted items.

These improvements are indeed consistent with Ameritech Services' objective of providing high quality, low cost warehousing functions for its five Telecommunications Companies.

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